

WHAT IS CLAIMED IS:

- 1 1. A temperature-compensated, micromechanical resonator
2 device comprising:
 - 3 a substrate;
 - 4 a flexural-mode resonator having first and second ends; and
 - 5 a temperature-compensating support structure separate from the
6 resonator and anchored to the substrate to support the resonator at the first and
7 second ends above the substrate wherein both the resonator and a support structure
8 are dimensioned and positioned relative to one another so that the resonator has
9 enhanced thermal stability.
- 1 2. The device as claimed in claim 1 further comprising a drive
2 electrode structure formed on the substrate at a position to allow electrostatic
3 excitation of the resonator wherein the resonator and the drive electrode structure
4 define a first gap therebetween.
- 1 3. The device as claimed in claim 2 wherein the first gap is a
2 submicron lateral capacitive gap.
- 1 4. The device as claimed in claim 2 further comprising a sense
2 electrode structure formed on the substrate at a position to sense output current
3 based on motion of the resonator wherein the resonator and the sense electrode
4 define a second gap therebetween.
- 1 5. The device as claimed in claim 4 wherein the second gap is
2 a submicron lateral capacitive gap.
- 1 6. The device as claimed in claim 1 wherein the resonator is a
2 single resonator beam.
- 1 7. The device as claimed in claim 1 wherein the support
2 structure includes an anchor for rigidly anchoring the first end of the resonator to

3 the substrate and a folding truss support structure for substantially decoupling the
4 second end of the resonator from the substrate.

1 8. The device as claimed in claim 1 wherein the resonator is a
2 lateral resonator and wherein the support structure includes a pair of stress
3 generating support members dimensioned relative to the resonator so that the
4 resonator has enhanced thermal stability.

1 9. The device as claimed in claim 1 wherein the resonator is a
2 polysilicon resonator.

1 10. The device as claimed in claim 9 wherein the resonator is a
2 polysilicon resonator beam.

1 11. The device as claimed in claim 4 wherein the electrode
2 structures are metal.

1 12. The device as claimed in claim 11 wherein the electrode
2 structures include plated metal electrodes.

1 13. The device as claimed in claim 1 wherein the substrate is a
2 semiconductor substrate.

1 14. The device as claimed in claim 14 wherein the semiconductor
2 substrate is a silicon substrate.

1 15. The device as claimed in claim 1 wherein the support
2 structure does not substantially vibrate during vibration of the resonator.

1 16. The device as claimed in claim 1 wherein energy losses to the
2 substrate are substantially reduced to allow higher resonator device Q .

1 17. The device as claimed in claim 8 wherein the support
2 members are rigid against lateral motions.

1 18. The device as claimed in claim 7 wherein the anchor is an off-
2 axis anchor.

1 19. The device as claimed in claim 1 wherein the device is a
2 temperature sensor.

1 20. A micromechanical resonator device having a frequency
2 versus temperature curve, the device comprising:

3 a substrate;
4 a flexural-mode resonator having first and second ends; and
5 a support structure separate from the resonator and anchored to the
6 substrate to support the resonator at the first and second ends above the substrate
7 wherein both the resonator and a support structure are dimensioned and positioned
8 relative to one another so that the frequency versus temperature curve is specifically
9 tailored.

1 21. The device as claimed in claim 20 wherein the frequency
2 versus temperature curve is designed to increase temperature dependance of the
3 resonator.

1 22. The device as claimed in claim 20 wherein the frequency
2 versus temperature curve is designed to have peaks and valleys in predefined
3 locations.

1 23. A micromechanical resonator device comprising:
2 a substrate;
3 a flexural-mode resonator having first and second ends; and
4 a support structure separate from the resonator and anchored to the
5 substrate to support the resonator at the first and second ends above the substrate
6 wherein both the resonator and a support structure are dimensioned and positioned

- 7 relative to one another so that the device has a substantially zero temperature
- 8 coefficient temperature at which the device may be biased.